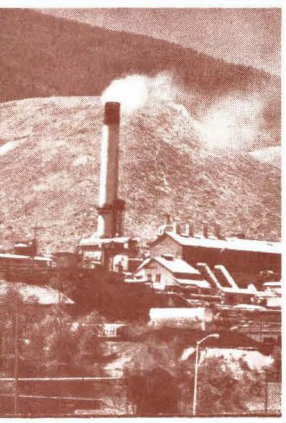
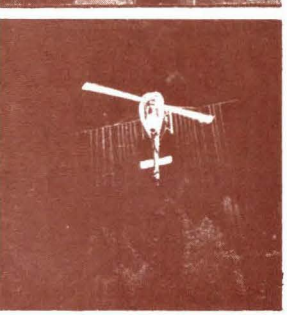
SB 761
U7N6
#75-10





FOREST ENVIRONMENTAL PROTECTION

USDA · FOREST SERVICE · NORTHERN REGION
State & Private Forestry · Missoula, MT 59801

Report No. 75-10

5200
April 1975

STATUS OF MOUNTAIN PINE BEETLE INFESTATIONS GLACIER NATIONAL PARK, 1974

by

M. D. McGregor, D. R. Hamel, R. C. Lood, and H. E. Meyer

ABSTRACT

Mountain pine beetle populations reached epidemic levels on approximately 4,600 acres in Glacier National Park in 1972. Infested trees increased from 4.9 in 1972 to 10.9/acre in 1975. Majority of trees killed since 1972 were 12 inches d.b.h. and larger in size. Sufficient large diameter lodgepole pine exists to maintain the infestation at epidemic level for several years.

INTRODUCTION

Mountain pine beetle, *Dendroctonus ponderosae* Hopk., has been responsible for considerable mortality of lodgepole pine, *Pinus contorta* Dougl., in Glacier National Park, Montana, since 1950 (Tunnock, 1970). At Starvation Ridge near Kintla Lake, the infestation ranged from no infested trees to as high as 4.4 infested trees per acre, average 0.4 per acre. However, acres infested did not vary between 1954 and 1967. During that time, approximately 7,960 lodgepole pine were killed.

In 1970, aerial detection surveys revealed several hundred new faders in Bowman and Quartz Creek drainages between Logging and Bowman Lakes. Number of infested trees increased annually with new infested groups varying from two to several hundred trees per group through 1971. In 1972, infestation occurred from Parke Ridge south to Trout Creek. Largest concentrated groups of infested trees were in the Quartz, Dutch, and Trout Creek drainages. In 1973, several thousand infested

LIBRARY
1978
ROCKY MOUNTAIN STATION

trees occurred in about 3,600 acres between Cummings and Quartz Creeks, with small groups of faders, 2 to 20 trees per group, scattered from Logging Lake to Bowman Lake. Detection surveys in Glacier National Park in 1974 showed epidemic conditions on approximately 4,630 acres. Largest concentration of infested trees occurred between Howe Lake and Dutch Creek. Approximately 1,200 acres contained epidemic infestation between Quartz Creek and Lone Pine Prairie, and the infestation north of Kintla Lake increased from 168 acres to in excess of 1,380 acres (Figure 1). To obtain an estimate of numbers of infested trees that have occurred, surveys were conducted in Camas Creek drainage and Cummings Meadow during November 1974.

METHODS

Estimates of number of infested trees were obtained by establishing 40 one-fourth acre plots at 5-chain intervals throughout a 40-acre block. A hypsometer was used to determine if trees fell within plot boundaries. Each infested tree 5 inches in diameter at breast height (d.b.h.) and larger was recorded by d.b.h. and categorized into one of the following classes:

0 = Green, uninfested.
1 = 1974 attack; green or partially faded foliage, brood in cambium, blue stain present.
2 = 1973 attack; red foliage; brood emerged.
3 = 1972 or prior attack; majority of needles dropped.
4 = Unsuccessful attack or pitchout; green foliage, pitchtubes present, brood and blue stain absent.

In addition twenty 1/10-acre plots were established to determine diameter-phloem distribution within the stand. A hypsometer was used to determine trees to be tallied within plots. Each tree tallied was recorded by diameter at breast height; and two phloem samples were removed from opposite sides of each of two trees in each diameter class per plot. Phloem thickness was measured to the nearest one-hundredth of an inch with a steel ruler.

RESULTS

The stand surveyed is mixed, consisting of lodgepole pine, 71.0 percent; Engelmann spruce, 12.7 percent western larch, 7.4 percent; Douglas-fir, 5.6 percent; subalpine fir, 2.1 percent; and 1 percent western white pine. Habitat type varies from *Abies lasiocarpa/Clintonia uniflora* to *Picea/Clintonia uniflora*. Infestation is heavier on the west-southwest aspect at elevations of 3,400 to 4,800 feet.

Tree mortality occurred in all diameter classes from 5 to 19 inches with the exception of the 17- and 18-inch diameters in 1972; 9- to 19-inch diameters were infested in 1973; and 5- to 19-inch diameters were infested in 1974. From 1972 to 1974, greatest tree mortality occurred in the 9- to 14-inch d.b.h. size class.

There were 4.9 infested trees per acre in 1972; 3.0 in 1973; and 32.6 in 1974. Buildup ratio of old to new attacks was 1:0.6 from 1972 to 1973, and

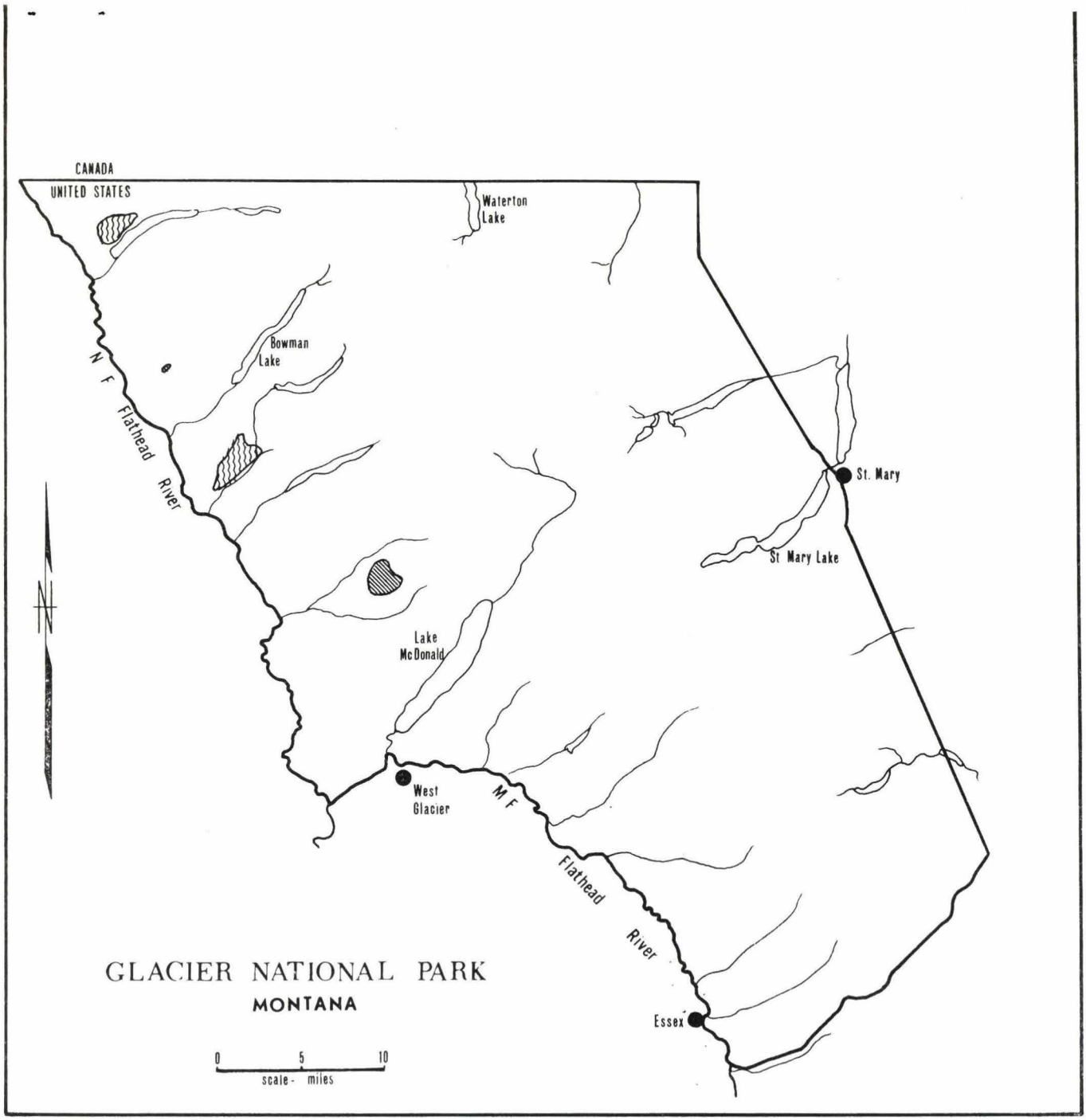


Figure 1.--Mountain pine beetle infestation, Glacier National Park, 1973-74.

1:10.9 from 1973 to 1974. Average diameter of infested trees was 7.8 inches in 1972; 12.4 inches in 1973; and 9.8 inches in 1974. In 1972, 28.5 percent of the lodgepole pine killed were 12 inches d.b.h. and larger; in 1973, 65.2 percent were 12 inches d.b.h. and larger; and in 1974, 50.5 percent of the trees killed were 12 inches d.b.h. and larger.

In trees attacked in 1974, phloem thickness ranged from 0.03 to 0.13 inch thick. In the residual green lodgepole pine measured, phloem depth ranged from 0.02 to 0.10 inch thick (Tables 1 and 2).

Approximately 39.8 percent of all trees measured during 1974 were greater than 12 inches d.b.h., and of these, 15.2 percent had a phloem greater than or equal to 0.10 inch thick. Approximately 17.6 percent of the remaining green lodgepole stand is 12 inches d.b.h. and larger in size, and 6.6 percent of these trees have phloem greater than or equal to 0.10 inch thick.

Table 1.--Summary of data from phloem measurements of infested lodgepole pine, Camas Creek, Glacier National Park, 1974

d.b.h.	Range	Mean	S.D.	S.E.
7	- 0.05	0.055	--	--
8	.03 - .08	.063	0.016	0.005
9	.04 - .10	.067	.014	.002
10	.04 - .10	.073	.014	.002
11	.05 - .10	.080	.015	.003
13	.05 - .11	.084	.016	.003
14	.05 - .11	.086	.014	.002
15	.06 - .10	.086	.013	.005
16	.05 - .13	.094	.026	.011
17	.07 - .10	.091	.012	.006
18	.06 - .07	.068	.011	.008
19	- .13	.130	.0316	.018

Table 2.--Summary of phloem measurements of residual green lodgepole pine, Camas Creek, Glacier National Park, 1974

d.b.h.	Range	Mean	S.D.	S.E.
5	0.02 - .10	0.049	0.026	0.010
6	.02 - .07	.048	.016	.005
7	.03 .08	.055	.017	.004
8	.04 - .10	.061	.018	.004
9	.04 - .12	.071	.019	.004
10	.05 - .10	.075	.014	.003
11	.05 - .11	.080	.017	.004
12	.04 - .09	.072	.015	.004
13	.05 - .10	.079	.019	.007
14	- .05	.055	--	--
15	.06 - .10	.081	.018	.009
16	--	--	--	--
17	.09	.090	--	--
18	.095	.095	--	--

Approximately 14.8 percent of the trees attacked since 1972 were attacked unsuccessfully. That is, beetles were unsuccessful in constructing egg galleries. This might be attributed to females not being mated.[1/] Unsuccessfully attacked trees averaged 10.0 inches d.b.h.

DISCUSSION

Mountain pine beetle outbreaks in Glacier National Park reached epidemic level in 1970. Size of area and number of new attacks increased through 1972, decreased in 1973, then increased sharply in 1974. Infested trees per acre increased from 4.9 in 1972 to 32.6 in 1974. Buildup ratio of old to newly attacked trees was 1:10.9 from 1973 to 1974. Average diameter of infested trees decreased from 1973 to 1974. Approximately one-half of the trees killed are 12 inches d.b.h. and larger.

According to Cole (1973) the number of trees killed during a mountain pine beetle outbreak is dependent on beetle population which is affected by:

(1) Phloem thickness.
(2) Tree diameter
(3) Stand density, and
(4) Habitat types.

Data collected during past epidemics show that the mountain pine beetle prefers larger diameter trees each year as well as over the life of an infestation (Gibson, 1943; Hopping and Beall, 1948; Cole and Amman, 1969; Safranyik, et al., 1974). Beetle survival increased with tree diameter (Reid, 1963; Safranyik, et al., 1974). Our data shows that the number of trees 12 inches d.b.h. and larger that were killed increased 36.7 percent from 1972 to 1973; and that over half of the trees killed during 1973 and 1974 were 12 inches and larger in diameter.

Approximately 1,800 acres are infested in the Camas Creek area. Of this, concentrated group infestation occurs on 555 acres, and scattered single tree and small group attacks on 1,245 acres. Based on buildup ratios from 1972 to 1974, and on the formula $y^1 = y+bx$ (Baker, 1968) where

y^1 = the potential cumulative number of trees killed predicted through next year (1975)
y = the cumulative number of trees killed through this year
x = number of trees killed this year (1974)
x_1 = number of trees killed last year (1973)
$b = \frac{x}{x_1}$

it is predicted that on the 1,800 acres of infested area mapped during aerial surveys, approximately 58,680 trees will be killed in the Camas

1/ Personal communication from G. D. Amman, Intermountain Forest and Range Experiment Station, Ogden, Utah, 1975.

and Cummings Creek drainages in 1975, bringing the cumulative total to 709,200 trees killed since 1972.

This infestation is expected to continue at epidemic levels until the larger diameter component of the stand is removed. As larger trees are killed and beetles move to smaller trees with thinner phloem, these trees produce fewer and smaller beetles (Safranyik and Jahren, 1970) in which we expect them to deposit fewer eggs (Amman, 1972). With the large volume of lodgepole pine available, this infestation could continue at its present epidemic level for 4 to 18 years.

It appears that a reduction of the large diameter host component of the stand or extreme low temperatures will be necessary to cause an infestation decline. Safranyik, et al. (1974) found that of all the life stages, eggs have the least tolerance to freezing temperatures, followed by pupae, adults, and larvae. Cold temperatures occurring between December and February cause greatest brood mortality. Temperatures near 0° F. could cause high egg and small larval mortality during winter months; and lower temperatures, such as are common in the North Fork Flathead River drainage, may result in considerable brood mortality. However, bark thickness, which is related to tree diameter, provides some insulation to larvae and could modify sublethal temperatures. Trees of small diameter usually have thin bark that provides less insulation to broods and results in greater mortality than occurs in large diameter trees (Cole, 1975). Because of the policy of the National Park Service to permit mortality as part of natural succession, control is not recommended. However, if the infestation continues at its present epidemic trend, a serious fire hazard may be created.

REFERENCES CITED

Amman, G. D. 1972. Mountain pine beetle brood production in relation to thickness of lodgepole pine phloem. J. Econ. Entomol. 65 (1): 138-140.

Baker, B. H. 1968. The use of "buildup ratio" as indication of mountain pine beetle population trends. Branch of Insect and Disease Prev. and Control, Fire Mgmt. USDA Forest Serv., Ogden, Utah, Office Rept., 6 pp.

Cole, W. E. and G. D. Amman. 1969. Mountain pine beetle infestations in relation to lodgepole pine diameters. USDA Forest Serv., Intermountain Forest and Range Expt. Sta., Ogden, Utah, Res. Note INT 95, 7 pp.

Cole, W. E. 1973. Interaction between mountain pine beetle and dynamics of lodgepole pine stands. USDA Forest Serv., Intermountain Forest and Range Expt. Sta., Ogden, Utah, Res. Note INT 170, 6 pp.

Cole, W. E. 1975. Interpreting some mortality factor interactions within mountain pine beetle broods. Environ. Ent. 4 (1): 97-102.

Gibson, A. L. 1943. Status and effect of a mountain pine beetle infestation on lodgepole pine stands. Forest Insect Lab., USDA Forest Serv., Coeur d'Alene, Idaho, 34 pp.

Hopping, G. R., and G. Beall. 1948. The relation of diameter of lodgepole pine to incidence of attack by the bark beetle, *Dendroctonus monticolae* Hopk., Forest Chron. 24:141-145.

Reid, R. W. 1963. Biology of the mountain pine beetle, *Dendroctonus monticolae* Hopkins, in the east Kootenay Region of British Columbia. III. Interaction between the beetle and its host, with emphasis on brood mortality and survival. Canad. Entomol. 95:225-238.

Safranyik, L., D. M. Shrimpton, and H. S. Whitney. 1974. Management of lodgepole pine to reduce losses from the mountain pine beetle. Pac. Forest Res. Center, Canadian Forestry Serv. Forestry Tech. Rept. 1, 25 pp.

Safranyik, L., and R. Jahren. 1970. Host characteristics, brood density and size of mountain pine beetles emerging from lodgepole pine. Dept. of Fisheries and Forestry of Canada, Bi-monthly Res. Note 26:35-36.

Tunnock A. S. 1970. A chronic infestation of mountain pine beetle in lodgepole pine in Glacier National Park, Montana. USDA Forest Serv., Missoula, Montana. J. Econ. Soc. B. C., Vol. 67, p. 73.